Space Weather Technical Forecast

Issued on Saturday, 27 January 2024 at 01:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 Minor Storms day 4 (30 Jan) from onset of CH94 fast winds. Chance of isolated M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C9.0, occurring at 26/0033 UTC and at 26/0459 UTC both from AR3561 now approaching the southwest limb. This has been the most active region on the disc, but has been declining and along with AR3555 will soon move over the horizon onto the far-side. There are six regions on the disc. AR3559, is a longitudinally wide region on the northwest-disc, but has also been simplifying into an open group with clear leader and trailer regions. This still has some moderate complexity with opposite polarity spots within both areas, but has remained stable despite this. The most notable growth has been in AR3560 in the southwest, which consists of three spots with penumbra but maintains a simple bipolar magnetic structure. Any other spots have remained small and simple.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds have been inconclusive for any notable arrivals, but have seen very weak speed increases, the first at around 26/0900 UTC, then weakly again at 26/1240 UTC and then more notably at 26/1955 UTC. These could have been due to very weak and glancing CMEs, with observed speeds by ACE and DSCOVR rising from background, below 400 km/s, to be slightly elevated at 450-500km/s. Density, however, remained at or below average. Interplanetary magnetic field (IMF), Bt, was initially weak, 5-7 nT, but did rise to 6-9nT between /0800-1745 UTC. The north-south component Bz remained mostly weak, between +7nT and -5nT, but did have a brief spell of moderate negative values 26/1200-1300 UTC with minimum -8nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet throughout (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold on a steady trend. At 27/0000UTC the 24-hour integrated fluence observation was 1.23e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity expected, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: Any previously expected CMEs have now likely passed or missed, however a couple of further CMEs from 23-24 Jan that are expected to miss just ahead of Earth cannot be ruled out for giving further very slight enhancement early on day 1 (27 Jan). Otherwise winds are expected to ease towards background days 1-3 (27-29 Jan) before the onset of the next fast wind enhancement, from coronal hole 95. Slightly elevated winds are expected to develop, with the potential for a spell of increased geomagnetic activity during the onset. Ongoing chance of an Unsettled to Active spell at first day 1 (27 Jan) but easing to be mainly Quiet. Increasing again to Unsettled to Active with any fast wind onset, most likely day 4 (30 Jan), with a chance of G1 Minor Storm intervals.

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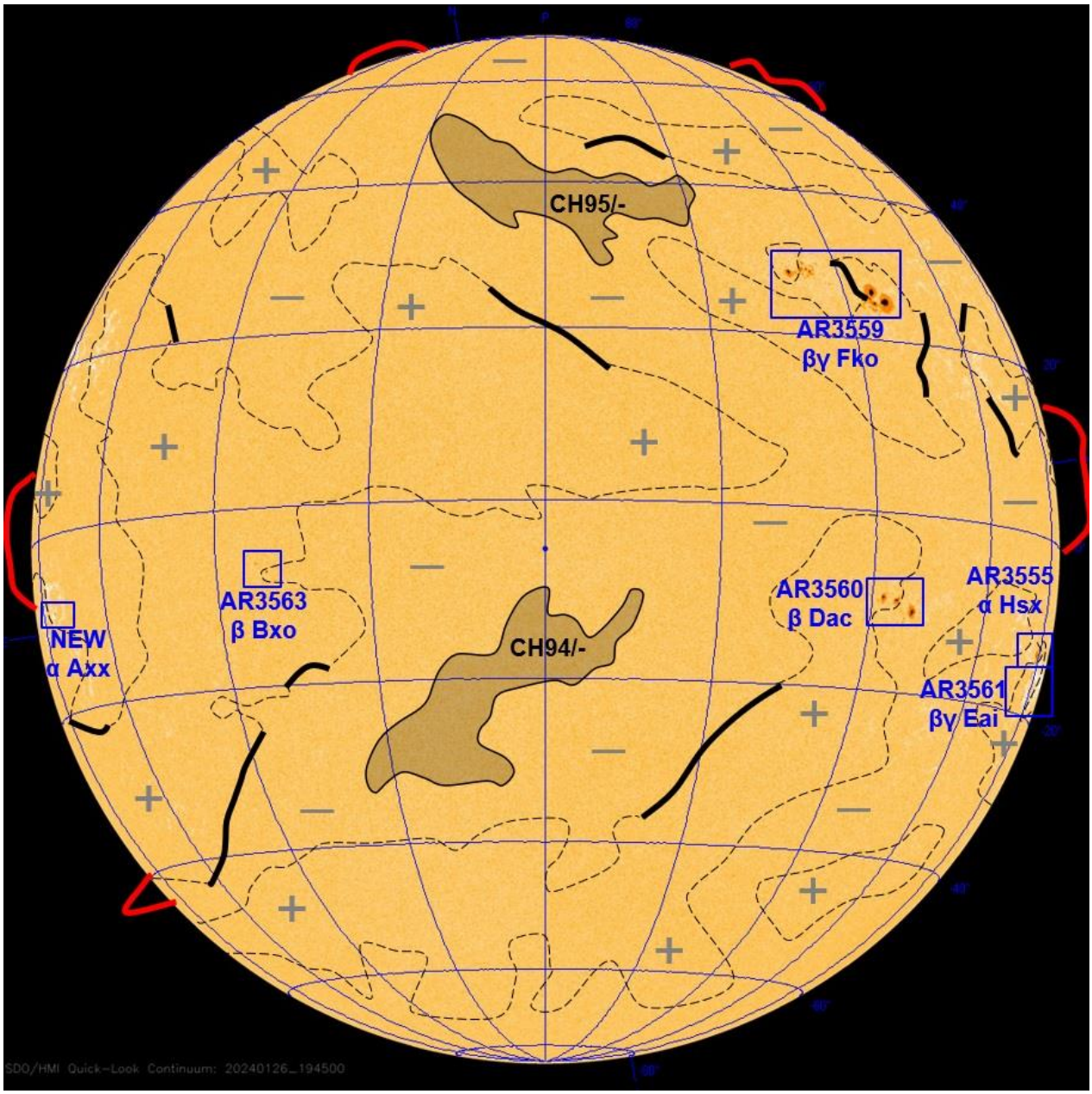
Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background with only a slight chance of rising to in response to any notable flares from the sunspots nearing the west limb. High energy electron (greater than 2MeV) flux is expected to persist at mainly background until at least day 4 (30 Jan), when an increase is then possible due to the onset of any fast winds, but most likely beyond this forecast period. The associated electron fluence remaining well below the Active threshold.

Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Recent CME glances have now likely passed Earth, with no further CME sourced enhancements expected. However with a couple of CMEs expected to miss, passing ahead of Earth on day 1 (27 Jan), further weak glances cannot be completely ruled out. These were primarily from the flare activity of AR3561 on 23-24 Jan.

Current slightly elevated winds are expected to ease towards background through days 1-3 (Jan 27-29) before the next enhancement from coronal hole 94/-. This is currently located with leading edge around 10W, and as a southern hemisphere feature is likely to be observed at Earth. This is also a persistent feature which produced limited enhancement on the last solar rotation, with only a weak enhancement currently indicated in enlil. Despite this, a stronger enhancement is considered likely on this occasion, most likely day 4 (30 Jan), with elevated winds expected.

This is due to the bulk of the hole being displaced further north, albeit also further east. Furthermore Earth is now further south of the ecliptic, while the Russell-McPherron effect brings the potential for a slightly stronger connection to negative coronal holes at this time of year. Although there is still some time until the March Equinox, when this effect is strongest, lowering this confidence. Along with the persistence of the coronal hole, this brings the greater potential for reasonable CIR region ahead of the fast wind onset, and subsequent geomagnetic activity. Coronal hole 95/- is likely too far north to influence conditions at Earth.

Any ongoing CME weak enhancement may bring Unsettled to Active intervals on day 1 (27 Jan) however mainly Quiet conditions are to develop and then prevail until either late day 3 or more likely day 4 (29-30 Jan). Any fast wind onset is then expected to bring Unsettled to Active geomagnetic activity with a chance of G1 Minor Storm intervals day 4 (30 Jan).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	5	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2a: Enlil showing weak CMEs ahead of Earth.

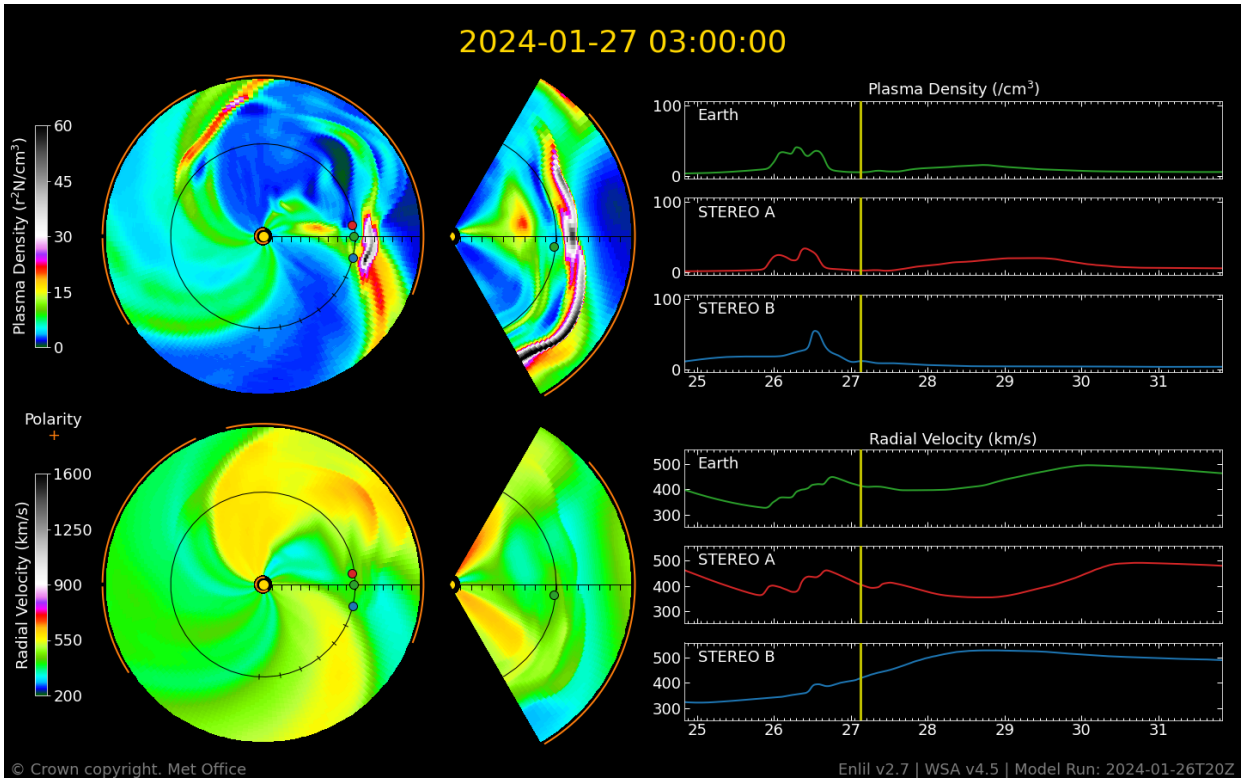
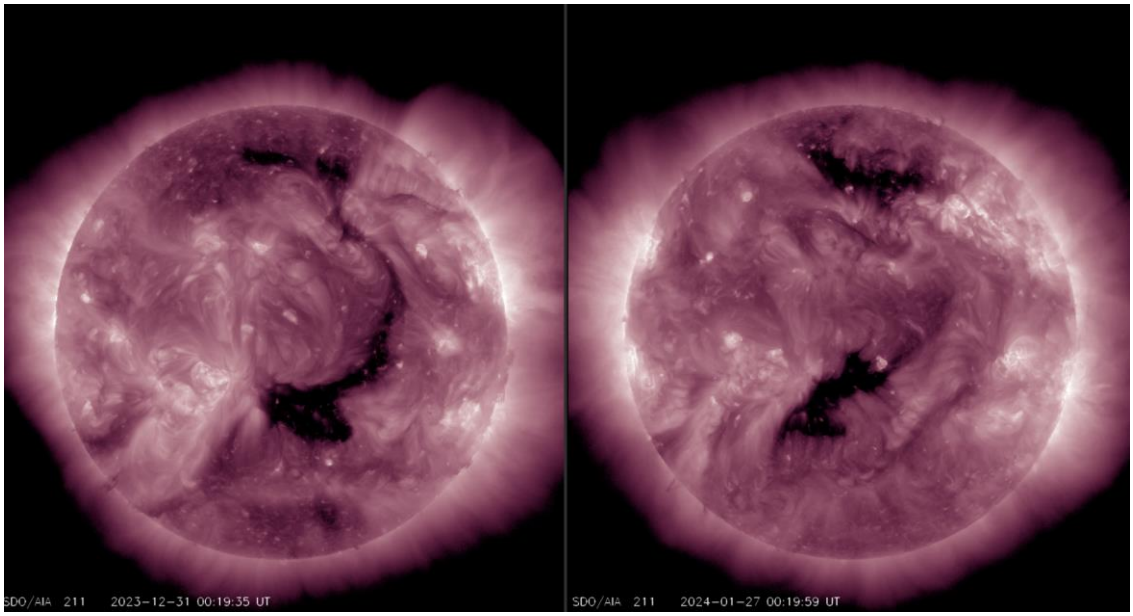


Figure 2b: SDO aia-211 of last rotation (left) and current rotation (right)



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Radio Blackouts - X-Ray Flares:

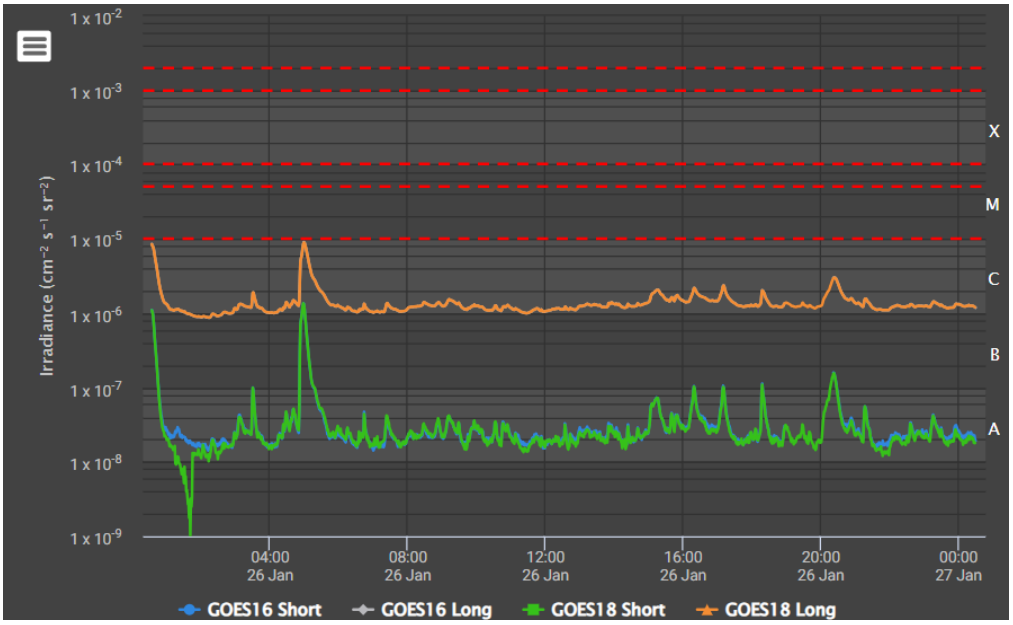
Low activity is likely to continue, but with a chance of isolated M-class flares.

The most active region is currently AR3561 with a couple of C9 flares observed on 27 Jan, and, alongside the simpler AR3555, this will soon move over the southwest limb on day 1 (27 Jan). Despite this, the region has the potential to still be an observable flare source into day 2 (28 Jan). AR3559 in the northwest is a longitudinally wide region, but has continued a simplifying trend into an open region with two distinct leader and trailer groups. While this maintains some complexity with the trailer region consisting of mixed polarities, the region has remained stable with no notable flaring since the M5 flare on 23 Jan.

The most notable growth has been in small region AR3560 in the southwest disc, with the growth and development of three small spots with maturing penumbra. This currently has a simple structure, but ongoing emergence to the south of the region suggests the potential for further growth and complexity to develop, and that this region is also a potential source for flare activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	30	35	40
Very Active	R3 to R5 X Class	No	2	2	1	1

Figure 3: GOES-16/18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is at background. Despite AR3561 and AR3559 showing signs of weakening, there remains a slight chance of any notable flares increasing the observed flux at Earth, with a very slight and reducing chance of reaching the S1 Minor Radiation storm level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron (greater than 2MeV) flux as observed by GOES16 is currently at background, and any enhancement from any glancing CMEs day 1 (27 Jan) is not expected to be sufficient to bring more than a modest increase to brief Moderate levels. Furthermore, this is only a low chance with the CMEs expected to miss. The next notable enhancement will be from the onset of the fast winds of coronal hole 94, with the observed flux rising later day 4 (30 Jan), or more likely beyond this forecast period, once the initial solar wind pressure from the onset of the fast winds eases.

The associated 24 hour fluence is forecast to persist at background levels. This is supported by REFM which is currently providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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